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ABSTRACT

A study examined determinants of wages and productivity in Mexico from 1993 and 1999 using two national surveys. In 1993, 7,619 employees from 575 firms were interviewed. In 1999, 6,259 employees from 722 firms were interviewed. Findings indicate that wage premiums and productivity increased with years of schooling, but workers had higher benefits from schooling than firms. Employers and employees benefitted the most from external training, whereas firms benefitted more from in-house training. Potential experience increased wages, but there were decreasing returns to potential experience. Workers benefitted more than firms from potential experience. Women were paid less than men in both years. Investment in men's education did not increase their wages or productivity to a level above women, but training did. There seemed to be no gender discrimination since wage differentials were explained by equal or larger productivity differentials. Union membership decreased wages across all sizes of firms, but union members were more productive than non-union members. In 1993 permanent workers earned less and were less productive than temporary workers. However, in 1999 permanent workers earned higher wages and were more productive than temporary workers. Foreign research and development and foreign ownership had a positive correlation with productivity and wages. The correlation of firm size with both wages and productivity was positive, but larger for productivity. Regional wage and productivity gaps increased over time. Three appendices explain the surveys and present variables and pooled estimation. (Contains 29 references.) (TD)

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Wages and Productivity in Mexican Manufacturing

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Abstract

This paper identifies the determinants of wages and productivity in Mexico over time using national representative linked employer-employee databases from the manufacturing sector. It shows that both employers and employees are benefiting from investments in education, training, work experience, foreign R&D and openness after NAFTA. Additional years of schooling have a higher impact on wages and productivity after NAFTA than before. Endogenous training effects are larger for productivity than for wages, suggesting that the employers share the costs and returns to training. It is also found that investment in human capital magnifies technology-driven productivity gains. By comparing four regions of Mexico – north, center, south, and Mexico City – regional wage and productivity gaps were found to have increased over time.

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Introduction

Since the introduction of the North American Free Trade Agreement (NAFTA), the dynamics of the Mexican economy have changed substantially. When NAFTA was introduced, manufactured products only accounted for 35 percent of Mexican exports. Since then, the manufacturing sector has grown to produce close to 90 percent of Mexican exports. However, the annual growth rate of labor productivity in Mexico is low compared to other developing countries (World Bank 1998a). Dar and others (2000) contend that one plausible explanation for the slow growth in labor productivity is that Mexican workers have a lower education level, resulting in the deficiency of human capital accumulation on-the-job as compared to elsewhere.[1]

The empirical evidence on the links between human capital (schooling), on the one hand, and productivity and wage growth on the other, is strong. Numerous studies using worker-level data have also shown that more educated and/or trained individuals are also more productive in a rapidly changing environment in which cognitive abilities to process new information are most important, and thus earn higher incomes (Welch, 1970; Mincer, 1989; López-Acevedo and Tan; 2002). Human capital (education) is viewed not only as an investment but also as a factor of production. Human capital is a stock of skills produced by education and training (Welch 1970 and Mincer 1989). Highly educated workers have a comparative advantage with respect to the adjustment and implementation of new technologies. For this reason, the productivity of highly-educated relative to less-educated workers is greater (Bartel and Lichtenberg 1987).

There is limited, but growing, empirical literature on the link between human capital (training) and firms' performance (Koning 1994; Revenga 1995; Batra and Tan 1995; Barrett and O'Connell 1998; World Bank 1998a, 1998b, 1999, 2000, 2001a, 2001b; Dearden, Reed, and Van Reenen 2000). Using panel data, several studies have

[1] The increase in wages associated with an additional year of work experience for Mexican men is low compared to the increase for men with similar educational attainment in other countries (3.8 percent in Mexico compared with 8.1 percent in United States, 8.4 percent in Japan, and 9.1 percent in France). This rate is low even when compared with the rate in countries at a similar level of development and with comparable education indicators, such as Brazil (6.2 percent) and Colombia (5.8 percent).

shown the positive impact of training on productivity (Nielsen and Rosholm 2002; Batra and Tan 1995; Dearden, Reed, and Van Reenen 2000).

Extensive literature has been compiled in the closely related field of the impact of human capital (training) on workers' wages. A consensus has nearly been made that earnings increase with more training. The increase is in the range of 20 percent in most developing countries (Middleton and others 1993; Dar and others 2000; Nielsen and Rosholm 2001).

Given the well-documented correlation between wage growth, on-the-job training, and productivity observed in many countries, the observed labor productivity growth rate difference between Mexico and elsewhere is consistent with the hypothesis that in Mexico post-school investment in human capital results in lower productivity growth. The observed low level of investment in human capital could also be explained by the incentive structure of labor regulations. In practice, as has been well-documented, firms appear to enjoy more flexibility than a strict interpretation of the law would suggest (World Bank 1999).

This paper analyzes wage and productivity determination in Mexico. This paper differs from previous labor market studies in Mexico in five ways. First, by using linked employer-employee datasets, this paper adds a new dimension to traditional wage analysis. Most wage studies only have detailed information about individual workers; however, this paper has detailed information about both individual workers and the firms. Second, the impact of employer and employee characteristics on wages and productivity before and after NAFTA is analyzed. Third, to assess the marginal impact of human capital and other characteristics on both wages and productivity, joint equations of wage and production functions are estimated. This methodology allows us to compare the impact that each variable has on wages with the impact that it has on productivity. In other words, how the distribution of benefits (in terms of wages and productivity) are shared by workers and firms Fourth, training is treated as an endogenous variable following Nielsen and Rosholm (2002). And fifth, restricting the sample set to firms of a

particular size firm-specific effects are estimated. Studies on wages and productivity in developing countries identify firm size as another significant determinant of wages and productivity (Tan and Batra, 2000). As noted by Brown and Medoff (1989), with all other factors being equal, large employers pay more than small employers. One way to explain this wage differential is that larger firms employ higher quality workers because of the greater capital intensity and capital-skill requirements of larger establishments.

This paper is organized by first introducing the data. Second, the descriptive statistics are presented. Third, the methodology is described. Fourth, the determinants of wages and productivity are analyzed by first analyzing employee characteristics and then by analyzing firm characteristics. The effects of variables on wages and productivity are compared. The wage and productivity effects of training treated as endogenous are also discussed. The final section offers the conclusions of these findings.

2. Data

The data used in this paper come from the National Survey of Employment, Salaries, Technology and Training (ENESTYC) and the National Survey of Employment to Workers in the Manufacturing Sector (ENTRAM)[2]. The data include observations from 1993 and 1999. INEGI (Instituto Nacional de Estadística, Geografía e Informática) has compiled the ENESTYC and ENTRAM. The ENESTYC gathers rich information on training, technology, wages, employment, forms of labor contracting, and internal plant organization of Mexican manufacturing firms. In 1993 the ENTRAM interviewed 7,619 employees from 575 firms in the ENESTYC survey. About 15 randomly selected workers from different occupational categories were interviewed in each company in 1993. In 1999 the ENTRAM interviewed 6,259 employees from 722 firms in the ENESTYC survey. About 10 randomly selected workers from different occupational categories were interviewed in each company in 1999.

The wage data was obtained from ENTRAM, as reported by the worker and converted to real 1997 pesos. The productivity per worker measure was calculated from

[2] For a full description of these surveys see Appendix A.

ENESTYC, using INEGI's methodology, that is, the difference between the value of the production of the firm and its expenditure in non-labor inputs in real 1997 pesos, then divided by the total number of workers in the firm.

The information on individual establishments that INEGI gathers through its questionnaires (which firms are required to answer by law) is legally confidential; therefore, we followed an established procedure in which most data analysis was done in INEGI's Aguascalientes headquarters with the support of INEGI personnel. Nevertheless, the reader should bear in mind the limitations for data analysis imposed by this institutional arrangement.

3. Descriptive Statistics

The distribution of relevant variables is tabulated, with sampling weights, in Table 1. [3] From this table, it is apparent that the percentage of female employees has increased from 1993 to 1999 by 6 percentage points. Manufacturing firms seem to be most concentrated in Central Mexico. According to the division of activity, basic metallic industries and other manufacturing industries increased their shares by the most – from 3 to 4 percent and from 1 to 5 percent, respectively. On the other hand, the share of the wood and wood products industry decreased the most – from 7 to 4 percent. The percentage of firms with more than 50 percent foreign capital increased from 15 to 19 percent. The percentage of firms that invest in research and development (R&D) diminished from 57 to 33 percent; whereas, the percentage of firms that adopted new technology increased from 71 percent in 1993 to 86 percent in 1999. Small and medium firms decreased from 20 to 18 percent and from 35 to 18 percent, respectively. The share of micro firms tripled. Most significantly, the share of firms that export more than half of their products increased more than three times.

[3] For a complete list of variables see Appendix B.

Table 1: Percent share of some relevant variables

Variables	1993 Percent	1999 Percent	Variables	1993 Percent	1999 Percent
Gender			**The firm's foreign capital is more than 50% of firm's total capital**		
Female	28.97	34.87	No	85.12	80.92
Male	71.03	65.13	Yes	14.88	19.08
The worker belongs to a union?			**Firm's exports are more than 50% of output**		
No	50.09	56.75	No	93.39	75.75
Yes	49.91	43.25	Yes	6.61	24.25
In-house training			**The firm has quality controls**		
No	80.31	76.67	No	77.82	75.31
Yes	19.69	23.33	Yes	22.18	24.69
External training			**The firm invests in R&D**		
No	81.44	80.00	No	43.27	67.38
Yes	18.56	20.00	Yes	56.73	32.62
Type of worker			**Did the firm adopt new technology?**		
Eventual	21.80	20.21	No	29.08	13.59
Permanent	78.20	79.79	Yes	70.92	86.41
Division of activity			**Size**		
Food, beverages, and tobacco	22.62	19.62	Micro	5.71	17.11
Textiles, clothing and leather	15.46	18.93	Small	20.25	17.86
Wood and wood products	6.94	4.39	Medium	34.88	14.49
Paper, paper products, printing, and publishing	5.33	5.38	Large	39.16	50.54
Chemicals, oil derivatives, and coal	11.01	11.64	**Region**		
Non-metallic mineral products	5.09	5.16	North	27.70	32.63
Basic metallic industries	3.09	4.20	Center	43.24	45.93
Metallic products, machinery, and equipment.	29.43	25.47	South	4.42	5.62
Other manufacturing industries	1.04	5.21	Mexico City	24.64	15.81

Source: Author's calculations based on ENTRAM-ENESTYC.

Table 2 shows the increasing importance that human capital has had on firms; meaning that the effect has become more important since NAFTA took effect. All of the indicators increased from 1993 to 1999. A significant increase in all types of training can be seen between the two years. The average number of years of education increased as well by about 8 percent. The only indicator that decreased was seniority by 4 percent.

The analysis here will focus on formal training only, that is the training provided in-house in firm training programs or by external sources. Formal in-house or in-service

training courses are given by firm personnel. External training describes formal training courses given by external agents. Most of the training is provided by private institutions.

Table 2: Distribution of the Human Capital Variables

Variable	1993		1999	
	Mean	Std. Dev.	Mean	Std. Dev.
Training	38.24%	-	43.33%	-
In-house training	19.69%	-	23.33%	-
External training	18.56%	-	20.00%	-
Years of education	9.10	3.98	9.82	3.25
Seniority	15.40	11.51	14.82	10.60

Source: Author's calculations based on ENTRAM-ENESTYC.

Table 3 shows the percentage of training according to various factors such as gender, location of firm, and size of firm. It is apparent that male workers received more training than females in both 1993 and 1999, in both external training and training in general. In 1993 and 1999, the percentage of males and females who received in-house training was about the same, but the percentage of females was slightly higher in both

Table 3: Distribution of Training variables

Variable	1993			1999		
	Training	In-house Training	External Training	Training	In-house Training	External Training
Female Workers	34.13	19.91	14.22	41.47	23.91	17.55
Male Workers	39.92	19.59	20.32	44.32	23.02	21.30
North	34.61	18.65	15.97	42.21	23.89	18.32
Center	43.87	22.92	20.95	45.29	23.66	21.63
South	37.24	14.01	23.23	31.58	13.34	18.24
Mexico City	32.62	16.19	16.43	43.48	24.01	19.47
Micro Firms	14.73	8.82	5.90	10.37	4.42	5.95
Small Firms	23.43	9.12	14.31	29.34	12.39	16.95
Medium Firms	35.60	14.25	21.35	47.03	21.84	25.19
Large Firms	51.68	31.57	20.11	58.37	34.03	24.34

Source: Author's calculations based on ENTRAM-ENESTYC.

years. All measures of training for both genders increased from 1993 to 1999. In terms of the location of firm – North, Center, South, and Mexico City – all firms increased their training between the two years with the exception of southern firms. With respect to the size of the firm, training is positively correlated with firm size in both years. Furthermore, training increased from 1993 to 1999 in all firm sizes except in micro-sized firms.

Table 4 presents the average logarithms of both productivity and wages of the workers. All of the results have been categorized by various types of training – training, no training, in-house training, and external training. By using the average wage of firms in the sample in 1993 and 1999 – 6.89 and 7.81, respectively – we can then compare the effects of training on wages. In all cases, having training, having in-house training, and having external training all appear to be related to higher wages in both 1993 and 1999. Not surprisingly, the reverse was also true in that having no training at all, having no in-house training, and having no external training, all appear to be related with wages below the average. Concerning productivity, those firms that provided their workers with training were more productive in both 1993 and 1999. Not surprisingly, those firms that did not provide any training were not as productive as the national average.

Table 4: Mean Value of wages and productivity

Variable	Wages 1993	1999	Variable	Productivity 1993	1999
Mean log wage	6.89	7.81	Mean log productivity	3.52	4.54
Mean log wage no training	6.69	7.63	Mean log productivity no training	3.37	4.22
Mean log wage training	7.20	8.05	Mean log productivity training	3.75	4.95
Mean log wage no in-house training	6.88	7.80	Mean log productivity no in-house training	3.44	4.41
Mean log wage in-house training	6.92	7.85	Mean log productivity in-house training	3.83	4.98
Mean log wage no external training	6.75	7.70	Mean log productivity no external training	3.48	4.44
Mean log wage external training	7.49	8.28	Mean log productivity external training	3.67	4.92

Source: Authors' calculations based on ENTRAM-ENESTYC

The effect of training had a greater positive effect on wages in 1993 than in 1999 with the exception of in-house training in which the effect was similar for both years. On the other hand, the effect of productivity was greater in 1999 than in 1993 for all types of training. In the following section, the trend described in this section are analyzed formally using a regression framework.

4. Methodology

First, a general model that contained all relevant explanatory variables was formulated. Second, eliminating statistically insignificant variables one at a time reduces this model to a more concise one. Workers are the unit of observation, and both workers and firm's characteristics are included in the individual vector of variables. The dependent variables are monthly wages and value added-productivity per worker. The equations are estimated jointly (sureg) to make the link between wages and productivity.

Let P be a 2 column matrix containing wages and productivity, Z a matrix of worker's characteristics such as age, years of education, time working for that firm, potential experience, training, gender, union membership, and type of contract. X is a matrix of firm characteristics such as research and development (R & D), new technology adoption, ownership, age, export orientation, quality control, firm size, region, and sector of activity. The regression error is ε. The coefficients are the vectors α and β.

$$P = \alpha \cdot Z + \beta \cdot X + \varepsilon \qquad (1)^4.$$

Since the independent variables are the same in the system, seemingly unrelated regression equations (sureg) are equivalent to the OLS estimation, equation by equation. By estimating (1) as a system, there is a gain in efficiency since the disturbances in the wage and productivity equations are contemporaneously correlated. Further, the joint

[4] Verner (1999) argues that, in general, this methodology may cause aggregation biases; it may : (1) overestimate the firm effect, namely productivity; and (2) underestimate the individual effect on wages and productivity. A multilevel estimation takes into account aggregation biases; however, the small firms have too few employees to enable us to perform the multilevel analysis.

estimation allows us to test for the equality of the coefficients in (1). In order to avoid aggregation biases, equation (1) was also estimated by firm size.

5. Results

This section discusses the results of the estimation using both wages and value added productivity[5]. The employee characteristics that are examined include the following: (i) schooling; (ii) training; (iii) potential experience; (iv) gender; (v) union membership; and (vi) type of contract. The characteristics of the firms that are examined are: (i) R&D; (ii) export orientation and foreign ownership; (iii) quality control; (iv) firm size; (v) location; and (vi) sector of activity. For every relevant variable, the estimation (with sampling weights) was done for all firms, which are the pooled coefficients. Then the estimation was done for every group of firms, classified by size, so that we were able to differentiate the effect by firm size.[6]

Individual Characteristics of Employees

i. Schooling

Education has been singled out as the most important factor in determining wages and earnings inequality in Mexico. This realization has increased the importance of education over time. Not surprisingly, the results of the wage-productivity equation indicate that schooling increases wages as can be seen in Table 5. The coefficients are significantly different from zero in both 1993 and 1999 for all firm sizes.

These findings are not surprising. A worker receives higher wages with more education, conditional on other relevant individual characteristics as well as on characteristics of the firm. In the 1999 findings, an additional year of schooling was shown to yield a 10 percent increase in wages versus the 9 percent found in the 1993 findings. Typical rate of return studies in Mexico show that schooling increases wages

[5] Joint estimation using wages and average product per worker were also estimated. The results are similar to those discussed in this paper. Results are available upon request.

[6] The results of the pooled joint estimations are on Appendix C. The results by firm size are available upon request.

by 10 percent (World Bank, 1998a). This finding suggest that education returns have not been overstated in typical rate of return studies that ignore training and demand factors – the firm characteristics.[7]

Table 5: Schooling

Variable	1993				1999			
Edu	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.09	0.00	0.02	0.00	0.10	0.00	0.04	0.00
Micro	0.07	0.00	0.07	0.04	0.07	0.00	0.05	0.16
Small	0.10	0.00	0.01	0.37	0.09	0.00	0.08	0.00
Medium	0.09	0.00	0.00	0.64	0.10	0.00	0.00	0.81
Large	0.09	0.00	0.02	0.15	0.10	0.00	0.05	0.01

Source: Author's calculations based on ENTRAM -ENESTYC

An additional year of schooling yields a 10 percent increase in wages in small, medium and large firms, but only 7 percent in micro firms. However, additional schooling has a greater productivity enhancing effect for workers in micro and small firms. In micro firms, however, the effect of schooling on productivity decreased over time by 2 percentage points.

The results also reveal a positive and statistically significant effect of schooling on productivity in both 1993 and 1999 (an increase from 2 to 4 percent). The positive effect of schooling on productivity in large firms in 1999 is statistically significant compared to 1993.

However, the hypothesis which states that the effect of education on wages and productivity would be the same must be rejected since the difference was greater for wages, meaning that workers' benefits are higher than those of firms.[8] This means that workers have greater benefits than firms from schooling.

[7] A potential source of bias could arise in standard rate of returns to schooling studies because most of them do not control for the ability of the individual. Card (2001) uses several instruments to correct this problem. He shows that the coefficient of the schooling variable is even larger after controlling for the endogeneity of schooling.

[8] We performed hypothesis tests for the equality of the wage and productivity coefficients. Results are on Appendix C.

ii. Training

The regression results indicate that in-service training accounted for higher wages in 1999 but not in 1993(see Table 6). In-house training is positively correlated to productivity in 1993. In 1999, in-house training had a positive and significant effect on wages and productivity in medium size firms. In 1993, only the firms benefited from in-house training.

Table 6: In-house Training

Variable	1993				1999			
Teachi	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	-0.13	0.00	0.16	0.04	0.05	0.06	0.07	0.30
Micro	-0.80	0.00	2.83	0.00	0.06	0.81	-0.09	0.87
Small	-0.12	0.37	-0.03	0.90	-0.09	0.20	-0.29	0.11
Medium	-0.02	0.85	0.03	0.84	0.09	0.03	0.44	0.00
Large	-0.07	0.24	0.05	0.60	0.03	0.50	-0.01	0.95

Source: Author's calculations based on ENTRAM-ENESTYC.

In 1999, workers who received external training earned, on average, 26 percent higher wages (see Table 7). This result accounts for a productivity increase of only 14 percent for workers who received external training. Thus, training obtained outside a firm increases productivity. This finding suggests that employees benefit the most from external training with a 26 percent wage premium compared to 5 percent from in-house training. In 1999, we cannot reject the hypothesis of equality of coefficients for external training on the wages and productivity estimates, which suggests that both employers and employees are benefiting equally from external training.

Table 7: External Training

Variable	1993				1999			
Teachx	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	-0.16	0.00	0.07	0.40	0.26	0.00	0.14	0.08
Micro	-0.87	0.00	0.44	0.41	0.33	0.01	-0.17	0.58
Small	0.05	0.68	0.35	0.06	0.10	0.12	-0.04	0.79
Medium	-0.05	0.41	0.09	0.41	0.25	0.00	0.47	0.00
Large	-0.25	0.00	-0.20	0.10	0.25	0.00	0.09	0.51

Source: Author's calculations based on ENTRAM-ENESTYC.

The wage return of both in-house and external training changed from being negative in 1993 to being positive in 1999, which suggests a growing demand for skills since NAFTA took effect.

Does Mexico under invest in training? The answer appears to be that it does as indicated by the very high returns to training, which actually serves to show that this type of training is scarce.

The returns to training also vary by firm size and by year. For example, in 1999, external training was positively correlated with workers' wages in micro, medium, and large firms (33, 25, and 25 percent, respectively). One implication of the external training results is that policies that encourage increased training will lead to larger productivity gains for the economy. Gains that firms receive from training and foreign ownership (discussed below) are shared with employees in the form of higher pay.

Are rates of return to training associated with complementary investments in technology? Considering the joint effect of training with technology adoption increases wages, but it simultaneously seems to decrease productivity (Tables 8 and 9). A plausible explanation for this is that training only has a positive effect in certain types of technology adoption. For example, the results indicate that combining in-house training with the acquisition of new numerically controlled computerized machinery increases productivity by 44 percent.[9]

Table 8: Technology Adoption and In-house Training

Variable	1993				1999			
Tatri	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.08	0.04	-0.36	0.00	0.06	0.36	0.20	0.25
Micro	-0.07	0.76	-2.11	0.00	0.29	0.38	-0.46	0.58
Small	0.16	0.20	-0.01	0.95	0.11	0.36	0.10	0.73
Medium	0.05	0.42	-0.22	0.02	0.08	0.47	0.56	0.03
Large	0.07	0.26	-0.29	0.00	0.13	0.36	-1.26	0.00

Source: Author's calculations based on ENTRAM-ENESTYC.

[9] Results disaggregating different types of technology adoption are available upon request.

Table 9: Technology Adoption and External Training

Variable	1993				1999			
Tatrx	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.08	0.03	-0.11	0.08	0.03	0.65	-0.23	0.13
Micro	0.19	0.44	-0.55	0.22	0.18	0.34	-0.50	0.29
Small	0.02	0.82	0.03	0.81	-0.15	0.17	-0.89	0.00
Medium	0.03	0.60	-0.25	0.00	-0.05	0.41	-0.06	0.83
Large	0.12	0.04	-0.02	0.85	0.14	0.30	-0.67	0.07

Source: Author's calculations based on ENTRAM -ENESTYC.

Endogenizing Training

Following Nielsen and Rosholm (2002), we control for selectivity bias of training. A Treatment Effects Model (Treatreg) was estimated to endogenize the training variable. Outcome P (wages or productivity) is a function of explanatory variables in Z (workers' characteristics) and X (firms' characteristics). Training (TR), that enters in vector Z in equation (1) is considered as an endogenous variable (our treatment variable). The binary decision to obtain the treatment TR is modeled as the outcome of an unobserved latent variable which represents the expected present value of returns to training, TR^*. It is assumed that TR^* is a linear function of the exogenous covariates Q that includes the variables in Z and X and the instruments (marital status of the worker and number of economic dependents of the employee)[10], and a random component u. The outcome and training equations can be written as a system of equations:

$$P = \alpha \cdot Z + \beta \cdot X + \varepsilon \qquad (1)$$

$$TR^* = \gamma \cdot Q + u \qquad (2)$$

Where the worker trains according to this rule:

$$TR = 1, \quad if \quad TR^* > 0$$

$$0, \quad otherwise$$

Table 10 summarizes the training results of the treatreg and sureg estimations. In 1999, the coefficient of the training variable in the wage equation increased from 0.13 to 0.78. The coefficient of the external training variable increased from 0.26 to 0.77. In the

[10] Test of the instruments were performed, results are available upon request.

productivity equation, the coefficient of the training variable increased from 0.10 to 0.94. The coefficient of the external training variable increased from 0.14 to 0.23.[11] One possible explanation for the negative correlation is that firms are more likely to train when demand (and the opportunity cost of labor's time) is low.[12] We are not convinced by this explanation but are unable to offer an alternative. We note, however, that several other studies have reported similar findings with endogenized training for a variety of countries at different stages of development, e.g. Dearden, Reed, and Van Reneen (2000) on British industry, Tan and Batra (1995) on manufacturing in five middle-income countries in East Asia and Latin America, and Nielsen and Rosholm (2002) on three African countries.

Table 10: Coefficients for Training

Wage equation coefficients			Productivity equation coefficients		
	Exogenous Training	Endogenous Training		Exogenous Training	Endogenous Training
Training	0.13	0.78	Training	0.10	0.94
External training	0.26	0.79	External training	0.15	0.45

Source: Author's calculations based on ENTRAM-ENESTYC.

iii. Potential Experience

The model also includes workers' potential experience, which is defined as *age-S-6*, where *S* represents the number of years workers have accumulated in that firm. Both level and squared forms of potential experience were included in the model, which allowed for non-linearities. The results of the analysis were inline with the expected positive effects of potential experience on wages in 1993 and 1999 (see Table 11). The positive effect of experience on wages increases at a younger age, and it continues at an older age but at a decreasing rate. In 1999, potential experience has a positive effect on wages and productivity in all firm sizes. However, the hypothesis test indicates that workers benefit more than firms from potential experience.

[11] These results are available upon request.

[12] Dearden, Reed and Van Reneen (2000) make this argument to explain the tripling of productivity and wage impacts of training when training is endogenized.

Table 11: Potential experience

Variable	1993				1999			
Pexp	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.04	0.00	0.00	0.72	0.04	0.00	0.01	0.01
Micro	0.04	0.00	0.02	0.18	0.04	0.00	0.02	0.16
Small	0.05	0.00	-0.01	0.30	0.03	0.00	0.00	0.76
Medium	0.04	0.00	-0.01	0.04	0.04	0.00	0.00	0.56
Large	0.05	0.00	0.00	1.00	0.04	0.00	0.02	0.02

Source: Author's calculations based on ENTRAM-ENESTYC.

iv. Gender

This paper also examines the effect that gender has on both wages and productivity for various firm sizes. Not surprisingly, female employees were paid less than their male co-workers, but they were also less productive than men in both 1993 and 1999 (see Table 12). This finding indicates that the wage gap according to gender is due to productivity differentials. For 1993, the hypothesis test indicates that the productivity gap is much larger than the wage gap. However, in 1999, we cannot reject the hypothesis of the equality of coefficients of gender on the wage and productivity equations. This finding implies that there is no gender discrimination since wage differentials are explained by equal or larger productivity differentials.

Table 12: Gender

Variable	1993				1999			
Gen	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.21	0.00	0.40	0.00	0.25	0.00	0.29	0.01
Micro	0.27	0.11	0.69	0.03	0.32	0.03	0.64	0.08
Small	0.31	0.00	0.18	0.11	0.02	0.79	0.69	0.00
Medium	0.13	0.02	0.11	0.25	0.22	0.00	0.16	0.31
Large	0.18	0.00	0.56	0.00	0.17	0.03	0.02	0.92

Source: Author's calculations based on ENTRAM-ENESTYC.

By using interaction variables, we found some results that were surprising and some that were inline with our hypotheses. The results of the interaction variables show that investment in education of men does not significantly increase men's wages or productivity more than that of women (see Table 13).

Table 13: Education-Gender

Variable	1993				1999			
Edugen	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.00	0.82	-0.02	0.00	-0.01	0.11	-0.02	0.04
Micro	0.00	0.94	-0.03	0.32	-0.01	0.50	-0.05	0.19
Small	-0.01	0.13	0.01	0.63	0.01	0.38	-0.07	0.00
Medium	0.01	0.10	0.00	0.78	-0.01	0.43	0.00	0.83
Large	0.00	0.72	-0.03	0.00	0.00	0.93	0.00	0.92

Source: Author's calculations based on ENTRAM-ENESTYC.

By mixing the variables of training and gender, we found that training generally increases men's wages above that of women's (see Tables 14 and 15). In 1993 external training increased men's wages slightly more than in-house training did. In-house training, however, increased men's wages more in 1999 than in 1993 in large firms. External training increased men's wages by a higher percentage in 1999 than in 1993 in small firms. This generally shows a trend that training–especially external training–increased men's wages more than women's by a higher percentage over time.

In terms of productivity, training also increased men's productivity more than women's. In 1993 external training increased men's productivity by slightly more than in-house training did in large firms. Productivity in the case of men's in-house training in large firms in 1999 increased from 2 to 26 percent in just 6 years. Thus, over time training seems to increase productivity of men more than productivity of women, but we cannot make any definite conclusions as to whether productivity increases more with in-house or external training.

Table 14: In-house training-Gender

Variable	1993				1999			
Trigen	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.03	0.00	0.01	0.14	0.05	0.11	0.22	0.01
Micro	0.05	0.11	-0.17	0.00	-0.09	0.73	0.02	0.98
Small	0.02	0.15	0.00	0.97	0.13	0.16	0.62	0.00
Medium	0.02	0.04	0.04	0.00	-0.05	0.29	-0.13	0.29
Large	0.02	0.00	0.02	0.09	0.10	0.04	0.26	0.05

Source: Author's calculations based on ENTRAM-ENESTYC.

Table 15: External training-Gender

Variable	1993				1999			
Trxgen	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.04	0.00	0.01	0.36	0.03	0.35	0.10	0.28
Micro	0.10	0.00	0.00	0.99	-0.01	0.96	-0.66	0.12
Small	0.03	0.01	-0.02	0.25	0.15	0.05	0.42	0.03
Médium	0.03	0.00	0.00	0.88	-0.02	0.75	-0.28	0.02
Large	0.05	0.00	0.03	0.00	0.02	0.74	0.10	0.54

Source: Author's calculations based on ENTRAM-ENESTYC.

v. Union Membership

By studying union membership in this analysis, it became apparent that union membership reduces wages in Mexico across all firms. In 1993 and 1999, union members earned lower wages than non-union members (see Table 16) by 24 and 28 percent, respectively. This finding is surprising because studies from wage analysis in developed countries usually show that union members earn more than their non-union member colleagues. However, in another World Bank study (1999), it was found that unionization does not increase wages in Mexico.

Despite the decrease in wages that union members face, statistically significant numbers show that union members were more productive than non-members in both 1993 and 1999. The productivity gap is 17 percent in 1999 and 10 percent in 1993. However, further research is needed to establish whether union members themselves are more productive or if it is the firms they work for that are more productive.

Table 16: Union membership

Variable	1993				1999			
Lreg	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	-0.24	0.00	0.10	0.00	-0.28	0.00	0.17	0.00
Micro	-0.08	0.34	0.73	0.00	-0.11	0.12	0.05	0.76
Small	-0.10	0.00	0.12	0.01	-0.15	0.00	0.30	0.00
Medium	-0.30	0.00	0.03	0.39	-0.30	0.00	0.07	0.20
Large	-0.29	0.00	-0.02	0.71	-0.36	0.00	0.23	0.00

Source: Authors' calculations based on ENTRAM-ENESTYC

In 1993 union members earned lower wages than non-members by 10, 30 and 29 percent less in small, medium, and large firms, respectively. In 1999 the effect of union membership on wages by firm size was increasingly negative.

vi. Type of Contract

Both permanent and temporary worker contracts are examined in order to consider how these two types of contracts affect workers' wages and productivity. The main differences between the workers in these contracts are their employment benefits, the duration of these benefits, and their skills. Employers have been found to be more likely to invest in human capital if they were planning on retaining their employees over the long term.

Table 17: Type of contract

Variable	1993				1999			
Twork	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	-0.09	0.00	-0.09	0.00	0.03	0.04	0.07	0.07
Micro	-0.11	0.11	0.12	0.32	0.03	0.57	0.27	0.03
Small	-0.15	0.00	-0.03	0.61	0.04	0.33	0.17	0.05
Medium	-0.06	0.02	-0.09	0.04	0.02	0.39	0.02	0.76
Large	-0.09	0.00	-0.03	0.46	0.04	0.09	-0.11	0.11

Source: Authors' calculations based on ENTRAM-ENESTYC

Table 17 shows the estimated wage differentials associated with a worker's type of contract – temporary or permanent. In 1993 permanent workers earned an average of 9 percent lower wages and were 9 percent less productive than temporarily-employed workers. However, the results shifted in 1999, whereby permanent workers earned 3 percent higher wages and were 7 percent more productive than temporary workers. Furthermore, we cannot reject the test of hypothesis that the wage and productivity coefficients are equal.

Firm Characteristics

i. Research and Development

In 1993 R&D increased both wages and productivity. Wages increased by 2 percent, and productivity increased by 20 percent (see Table 18). However, this trend did not continue in 1999 since R&D and productivity were found to be strongly negatively correlated. However, foreign R&D was found to have a positive effect on both wages and productivity, by 19 and 90 percent respectively. [13]

Table 18: Research & Development

Variable	1993				1999			
Rd	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.02	0.08	0.20	0.00	0.02	0.52	-0.20	0.03
Micro	-0.14	0.09	0.23	0.13	0.03	0.81	0.59	0.05
Small	0.00	0.94	0.10	0.04	0.30	0.00	-1.15	0.00
Medium	0.02	0.37	0.10	0.00	-0.15	0.01	0.17	0.23
Large	0.03	0.21	0.29	0.00	0.02	0.73	-0.12	0.44

Source: Author's calculations based on ENTRAM-ENESTYC.

ii. Ownership and Export Orientation

The following two tables illustrate two important firm characteristics effects on wages and productivity. The two variables that are used are ownership structure and export orientation.

It is presumed that a firm with partial foreign ownership is more likely to be affiliated with international markets than a strictly Mexican-owned firm. In both 1993 and 1999, foreign ownership had a positive effect on productivity and wages, controlling for both firm and individual characteristics (see Table 19). Firms mostly owned by foreigners are statistically more productive than firms owned by locals, and they pay higher wages. In 1993 mostly foreign-owned firms were 54 percent more productive, and they paid 7 percent more than firms that had little or no foreign ownership. In 1999

[13] Results that include foreign R&D are available upon request.

mostly foreign owned firms were 28 percent more productive, and they paid 13 percent more than the mostly domestic-owned firms. Furthermore, from 1993 to 1999 the positive correlation of foreign ownership with wages in small, medium, and large firms increased substantially. The hypothesis test indicates that the productivity gap is larger than the wage gap meaning that firms benefit the most from foreign ownership.

Table 19: Foreign capital

Variable	1993				1999			
Fc	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.07	0.00	0.54	0.00	0.13	0.00	0.28	0.00
Micro	-0.04	0.88	0.07	0.88	-	-	-	-
Small	0.18	0.05	1.17	0.00	0.38	0.00	-0.98	0.00
Medium	0.07	0.09	0.41	0.00	0.13	0.00	0.61	0.00
Large	0.07	0.02	0.56	0.00	0.10	0.00	0.35	0.00

Source: Author's calculations based on ENTRAM-ENESTYC.

Surprisingly, the size of export share is associated with lower wages and productivity in 1993 and with lower productivity in 1999 (see Table 20). Productivity in 1993 was shown to be negatively correlated with export orientation in all sizes of firms except micro. In 1999 productivity was still negatively correlated with export orientation, although to a lesser degree.

Table 20: Export Share

Variable	1993				1999			
Exp	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	-0.13	0.00	-1.09	0.00	-0.01	0.62	-0.25	0.00
Micro	0.01	0.98	1.21	0.00	-0.05	0.73	1.90	0.00
Small	0.10	0.32	-0.74	0.00	-0.10	0.08	-0.10	0.48
Medium	0.03	0.54	-1.37	0.00	-0.13	0.00	-0.34	0.00
Large	-0.23	0.00	-1.27	0.00	0.05	0.11	-0.42	0.00

Source: Author's calculations based on ENTRAM-ENESTYC.

iii. Quality Control

Empirical evidence suggests that a firm's introduction of quality control measures enhances its productivity and exports (see World Bank, 2001). Quality control only had a

positive correlation with wages in 1999 but not in 1993 (see Table 21). Furthermore, productivity was negatively correlated with quality control in 1993.

The correlation of quality control with productivity varies by firm size. For example, the introduction of quality control in 1999 increased productivity in small firms, but it decreased productivity in medium-size firms. Quality control did not have a correlation with productivity in micro or large firms in 1999. However, when comparing statistically significant productivity results for small firms in 1993 and 1999, productivity seems to increase over time.

Table 21: Quality control

Variable	1993				1999			
Qc	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.04	0.27	-0.23	0.00	0.08	0.05	0.15	0.16
Micro	0.20	0.49	0.84	0.12	0.21	0.23	0.05	0.91
Small	-0.18	0.67	-2.59	0.00	0.05	0.63	1.55	0.00
Medium	0.06	0.35	0.06	0.59	-0.15	0.02	-0.78	0.00
Large	0.03	0.51	-0.54	0.00	0.05	0.37	0.05	0.74

Source: Author's calculations based on ENTRAM-ENESTYC.

iv. Sectors

Industry-specific factors were measured by including dummy variables for each of the nine major manufacturing sectors: (1) food, beverages, and tobacco; (2) textiles, clothing, and leather; (3) wood and wood products; (4) paper and paper products; (5) chemicals, oil derivatives, and coal; (6) non-metallic mineral products; (7) basic metal industries; (8) metal products, machinery, and equipment; and (9) other manufacturing industries.

Controlling for other firm and individual characteristics, the estimations show that in 1993 employees working in sectors other than the food, beverages, and tobacco sector earned around 10 percent more than them, except for the wood and products and the other manufacturing industries (see Table 22). However, only basic metal industries showed superior productivity compared to the food sector by 21 percent more. In 1999 workers in all other sectors —other than food, beverages, and tobacco— received higher wages,

while only basic metal, chemicals, oil derivatives, and coal demonstrated higher productivity.

Table 22: Sector of activity

Variable	1993				1999			
Div	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
div922	0.09	0.00	-0.41	0.00	0.05	0.03	-0.45	0.00
div923	0.00	0.92	-0.73	0.00	-0.02	0.49	-0.47	0.00
div924	0.08	0.00	-0.43	0.00	0.05	0.10	-0.01	0.90
div925	0.08	0.00	-0.09	0.02	0.08	0.00	0.30	0.00
div926	0.11	0.00	-0.71	0.00	0.04	0.18	-0.58	0.00
div927	0.07	0.07	0.21	0.00	0.06	0.05	0.64	0.00
div928	0.03	0.05	-0.33	0.00	0.07	0.00	-0.04	0.49
div929	0.06	0.29	-0.60	0.00	0.04	0.29	-0.37	0.00

Source: Author's calculations based on ENTRAM-ENESTYC.

v. Location

The following regions (1) the North, (2) the Center, (3) the South, and (4) Mexico City were considered in terms of their influence on wages and productivity.

In 1993, workers employed in southern firms earned lower wages by an average of 21 percent than those employed in northern firms located near the border with the United States. In 1993, employees in Mexico City earned 6 percent higher wages than northern workers; however, in 1999 this distribution shifted dramatically. Established firms in the central, southern, and Mexico City regions paid lower wages than their northern counterparts by 12; 32; and 10 percent, respectively. The southern regions have always paid the lowest wages. However, the northern region has surpassed Mexico City in terms of the wages it pays. This is possibly due to its proximity to the United States and the favorable conditions that has brought for the region since the initiation of NAFTA (Esquivel et. al. 2002).

With respect to productivity, firms in Mexico City were 6 percent less productive than northern firms in 1993. In 1999 firms located in the central region were 13 percent more productive than northern firms, while southern firms were 25 percent less

productive (Table 23). Thus, southern firms have shown to not only pay less wages, but they are also less productive.

Table 23: Region

Center

Variable	1993				1999			
reg2	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.01	0.69	-0.03	0.30	-0.12	0.00	0.13	0.00
Micro	-0.10	0.25	-0.36	0.03	-0.29	0.00	-0.13	0.28
Small	0.06	0.16	0.35	0.00	-0.14	0.00	0.00	0.98
Medium	-0.04	0.17	-0.30	0.00	-0.10	0.00	-0.05	0.40
Large	0.04	0.10	0.15	0.00	-0.03	0.30	0.27	0.00

South

Variable	1993				1999			
reg2	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	-0.21	0.00	0.01	0.90	-0.32	0.00	-0.25	0.00
Micro	0.10	0.42	-0.20	0.40	-0.43	0.00	-0.50	0.02
Small	-0.30	0.00	0.18	0.17	-0.46	0.00	0.06	0.77
Medium	-0.30	0.00	-0.50	0.00	-0.18	0.00	-0.61	0.00
Large	-0.18	0.00	0.43	0.00	-0.22	0.00	-0.14	0.28

Mexico City

Variable	1993				1999			
reg2	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Pooled	0.06	0.00	-0.06	0.06	-0.10	0.00	-0.01	0.86
Micro	-0.09	0.34	0.02	0.92	-0.24	0.00	0.36	0.06
Small	0.02	0.68	-0.01	0.86	0.01	0.86	-0.46	0.00
Medium	0.05	0.10	-0.24	0.00	-0.12	0.00	-0.12	0.13
Large	0.09	0.01	0.07	0.17	-0.11	0.00	0.01	0.92

Source: Author's calculations based on ENTRAM-ENESTYC.

In 1999, micro firms –in the central, southern, and Mexico City regions paid lower wages than northern firms by 29; 43; and 24 percent, respectively. Small firms located in the center and in the south paid 14 and 46 percent, respectively, lower wages than northern firms. Medium-size firms paid 10, 18, and 12 percent (center, south, and Mexico City, respectively) lower wages than those firms located in the north. Finally, large southern firms paid 22 percent lower wages than large northern firms, and large

firms in Mexico City paid 11 percent less. Thus, southern firms paid the lowest wages across all sizes of firms compared to all of the other regions, and northern firms paid the most.

With respect to productivity in 1999, the greatest productivity differentials are found in southern micro and medium firms that were 50 and 61 percent, respectively, less productive than northern firms. Small firms in Mexico City were also found to be much less productive than small firms in the northern region (46 percent). In general, southern firms tend to be less productive.

vi. Firm Size

In 1993 productivity in small, medium, and large firms was higher than micro firms by 23, 30 and 27 percent, respectively. This productivity gap among firm sizes increased from 1993 to 1999. In 1999, small, medium, and large firms were more productive than micro firms by 38; 93; and 124 percent, respectively.

Table 24: Firm size (Pooled Estimation)

Variable	1993				1999			
Size	Wage	P>|z|	Productivity	P>|z|	Wage	P>|z|	Productivity	P>|z|
Small	-0.02	0.51	0.23	0.00	0.06	0.01	0.38	0.00
Medium	-0.04	0.38	0.30	0.00	0.15	0.00	0.93	0.00
Large	-0.10	0.06	0.27	0.00	0.25	0.00	1.24	0.00

Source: Authors' calculations based on ENTRAM-ENESTYC

In 1999 firm size was positively correlated with wages and productivity (see Table 24). With respect to wages, large firms paid close to 25 percent more than micro firms in 1999. The correlation of firm size with wages and productivity is positive, but the impact on the latter was shown to be far greater.

7. Conclusions

Using linked employee-employer manufacturing sector data (the ENTRAM-ENESTYC surveys from 1993 and 1999), this paper examined the micro-determinants of wages and productivity in Mexico. We used two kind of variables, those of the supply

side which are the workers' characteristics; and those of the demand side which correspond to the firms' characteristics.

First, the wage premium increased with the years of schooling. Furthermore, we found that the rate of returns to education have not been overstated in traditional wage equations. We might be underestimating the effect of the schooling coefficient in our estimation since we did not control for the endogeneity of this variable. An additional year of schooling in 1999 was shown to yield a 10 percent increase in wages. Furthermore, additional years of schooling were also shown to increase productivity. Rates of return to education by firm size increased from 1993 to 1999. The workers have higher benefits from schooling than firms.

Second, both employees and employers benefited the most from external training. The wage return, from in-house and external training changed from being negative in 1993 to being positive in 1999, but whereas in-house training only increased wages by 4 percent, external training increased wages by 26 percent. External training was not only shown to benefit the workers; employers who utilized external training enjoyed higher levels of productivity as well by an average of 14 percent. Firms were the only ones to benefit from in-house training in 1993, and it seems that employees and employers benefit equally from external training. Both productivity and wage impacts of training are even higher when training is endogeneized.

Third, potential experience was shown to have increased wages in both 1993 and 1999. However, there were decreasing returns to potential experience. Workers benefit more than firms from potential experience.

Fourth, on average women were paid less than men were in both 1993 and 1999, but they were also shown to be less productive than men. Furthermore, investment in men's education did not seem to significantly increase their wages or their productivity to a level above women; however, training did increase men's wages and productivity more

than for women. There seems to be no gender discrimination since wage differentials are explained by equal or larger productivity differentials.

Fifth, union membership was shown to decrease wages across all sizes of firms in both 1993 and 1999. Despite this decrease in wages, union members were shown to be more productive than non-union members; however, further research needs to be undertaken to determine whether union members themselves are more productive or if it is the firms they work for that are more productive.

Sixth, in 1993 permanent workers earned less and were less productive than temporary workers; however, these results changed in 1999 as permanent workers earned higher wages and were more productive than temporary workers.

As we have mentioned, we could not only rely on characteristics of the workers while ignoring characteristics of the firms that could very well also influence wages and productivity. For this reason, we chose six firm characteristics to examine in terms of the effect on wages and productivity.

First, R&D was shown to have increased both wages and productivity in 1993. However, this trend did not continue in 1999 as productivity was shown to be negatively correlated with R&D. Despite all of this, foreign R&D has a strong positive effect on wages and productivity.

Second, foreign ownership proved to have a positive and statistically significant correlation with productivity and wages in both 1993 and 1999. Firms benefit the most from foreign ownership. However, export-oriented firms seemed less productive in 1993 and 1999, and they paid lower wages.

Third, quality control was positively correlated with wages in 1999 but not in 1993. Furthermore, quality control was negatively correlated with productivity in 1993.

Fourth, this paper examines nine major manufacturing industries. Workers in the food, beverages, and tobacco industry were found to earn lower wages than the workers in the other industries; however, workers in these other industries were not much more productive.

Fifth, by comparing four regions of Mexico – north, center, south, and Mexico City – regional wage and productivity gaps were found. In terms of wages, southern firms paid the least. In 1993, firms in Mexico City paid their employees the highest wages, but in 1999 it was the northern firms. In terms of productivity, southern firms were also the least productive. Small southern firms exhibited the worst numbers in terms of their productivity. In 1993 northern firms were the most productive, but the central region surpassed the northern region in terms of productivity in 1999.

Sixth, larger firms were more productive and paid higher wages than the other firms. The correlation of size on wages and productivity is positive, but the impact on productivity is far greater than on wages. Whereas medium-sized firms were shown to be the most productive in 1993, small and large firms were nearly as productive. However, in 1999 large firms became much more productive than medium and small firms. Large firms were the most productive, followed in productivity according to size by medium, small, and then micro firms. Wages also followed the same trend in 1999 in that the large firms paid the highest wages.

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Appendix A

The national survey of employment, wages, technology, and training (ENESTYC)

There are two ENESTYC surveys collected by INEGI: one for manufacturing establishments and another for maquila-exporting firms. The unit of observation is the firm.

The universe for the manufacturing survey is the Economic Census updated with the Encuesta Industrial Mensual (EIM) and with information from the petrochemical industry. The maquila survey universe is the Economic Census. The manufacturing universe includes 54 activities and 309,157 establishments. The survey design is random, stratified at national level for each of the 54 activities, and for firm size. The selection is as follows:

1. Stratify establishments in four groups for each activity according to firm size (number of employees).
2. The sample selection is random and independent for each activity stratum.
3. The expansion factor is calculated as the inverse of the probability of selection.

The national survey of workers in the manufacturing sector (ENTRAM)

ENTRAM is also collected by INEGI. The universe is the worker of the establishments interviewed in the ENESTYC. The sampling design is random, bi-staged, and stratified for each of the 9 sub-sectors of the Clasificacion Mexicana de Actividades y Productos (CMAP) 1994 and by firm size. Establishments are selected in the first stage. Manufacturing workers are selected in the second stage. This process is as follows:

1. In each sub-sector, the establishments are stratified in four groups according to firm size (measured by number of workers).
2. In the first stage, à random sample of approximately 10 percent of firms is selected by stratum.
3. In the second stage, based in the payroll of the establishments, a random sample of 10 workers is selected from each firm distributed as follows:

    a) 1 manager (director)
    b) 3 employees
    c) 3 specialized workers
    d) 3 general workers

4. In the case of micro establishments with ten or less workers, all employees are interviewed.
5. The expansion factor is calculated as the inverse of the probability of selection.

APPENDIX B

Table B1: List of variables 1993-1999

Variable	Definition	Value
age	Age of the worker	Continuous
edu	Years of education of the worker	Continuous
time	Time working for that firm	Continuous
time2	Time working for that firm squared	Continuous
pexp	Potential experience	(age-time-6)
pexp2	Potential experience squared	$(age-time-6)^2$
gen	Gender	1 = male 0 = female
lreg	Worker's union	1= the worker belongs to a union 0 = otherwise
teachi	In-house formal training	1= the worker receives in-house training 0 = otherwise
teachx	External formal training	1=the worker receives external formal training 0 = otherwise
div#	Manufacturing industries: 1) Food, beverages, and tobacco. 2) Textiles, clothing, and leather. 3) Wood and wood products. 4) Paper, paper products, printing and publishing. 5) Chemicals, oil derivatives, and coal. 6) Non-metallic mineral products. 7) Basic metallic industries. 8)Metallic products, machinery, and equipment. 9) Other manufacturing industries	1=the firm belongs to certain industry 0=otherwise
reg#	Regions: 1) North. Includes the states of Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo León, Sinaloa, Sonora, Tamaulipas, and Zacatecas. 2) Center. Includes the states of: Aguascalientes, Colima, Guanajuato, Hidalgo, Jalisco, México, Michoacán, Morelos, Nayarit, Puebla, Querétaro, San Luis Potosí, and Tlaxcala. 3) South. Includes the states of Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, and Yucatán. 4) México City	1=the firm belongs to certain region 0=otherwise

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Variable	Definition	Value
size#	Firm size according to the number of workers: 1) Micro 1 - 15 2) Small 16 – 100 3) Medium 101 –250 4) Large 250 – more	1 = the firm belongs to a certain size 0 = otherwise
agef	Age of the firm in months	Continuous
direc	Percentage of directors working in the firm	Continuous
twork	Type of worker by his or her contract	1 = the worker has a permanent contract 0 = otherwise
fc	Foreign capital	1 = the firm's foreign capital > 50% 0 = otherwise
exp	Export orientation	1 = the firm's exports >50% of total production 0 = otherwise
rd	R&D	1 = the firm invests in R&D 0 = otherwise
qc	Quality control	1 = the firm has an external quality control (e.g. Iso-9000) 0 = otherwise
ta	Technology adoption	1 = the firm has adopted new technology in the year 0 = otherwise
tc#	Type of technology adopted 1 = manual equipment 2 = automatic equipment 3 = machinery tools 4 = machinery of numeric control 5 = computerized machinery of numeric control 6 = robots 7 = did not acquire machinery of equipment	1 = the firm has adopted certain new technology in the year 0 = otherwise
rdint	Foreign R&D	1 = R&D was done in a foreign country 0 = otherwise
orgch	Organizational change derived from TA	1 = organizational changes happened as a consequence of technology adoption 0 = otherwise
lh	log of the number of hours worked in the firm	Continuous
tatri	Interactive variable	ta*teachi
tatrx	Interactive variable	ta*teachx
edugen	Interactive variable	edu*gen
timtri	Interactive variable	time*teachi

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Variable	Definition	Value
timtrx	Interactive variable	time*teachx
sxdv#	Interactive variable	gen*div#
dv#ex	Interactive variable	exp*div#
agetri	Interactive variable	age*teachi
agetrx	Interactive variable	age*teachx
dv#thx	Interactive variable	div#*teachx
labtri	Interactive variable	lreg*teachi
labtrx	Interactive variable	lreg*teachx
agelab	Interactive variable	age*lreg
extri	Interactive variable	exp*teachi
extrx	Interactive variable	exp*teachx
dv#lab	Interactive variable	div#*lreg
rdlab	Interactive variable	rd*lreg
dv#fc	Interactive variable	div#*fc
dv#rd	Interactive variable	div#*rd
explab	Interactive variable	exp*lreg
fcexp	Interactive variable	fc*exp
rdtri	Interactive variable	rd*teachi
rdtrx	Interactive variable	rd*teachx
trigen	Interactive variable	teachi*gen
trxgen	Interactive variable	teachx*gen
teci#	Interactive variable	teachi*tc#
tecx#	Interactive variable	teachx*tc#
lmw	logarithm of the monthly wage	Continuous
lva	logarithm of the value added	Continuous

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APPENDIX C
Tables of pooled estimation

Table C1: Joint estimation for wages and productivity

	1993		1999	
Variable	Wages Coefficient	Productivity Coefficient	Wages Coefficient	Productivity Coefficient
Education	**0.0920**	**0.0211**	**0.0987**	**0.0444**
Pot.Exp.	**0.0430**	-0.0011	**0.0388**	**0.0124**
Pot.Exp.Sq.	**-0.0005**	-0.0001	**-0.0005**	-0.0001
Gender	**0.2087**	**0.3958**	**0.2485**	**0.2927**
In-houseTr	**-0.1304**	**0.1566**	**0.0482**	0.0714
ExternalTr	**-0.1624**	0.0650	**0.2553**	**0.1399**
Age Firm	-0.0006	-0.0008	**0.0001**	**0.0006**
Small	-0.0226	**0.2249**	**0.0571**	**0.3746**
Medium	-0.0369	**0.3005**	**0.1532**	**0.9315**
Lage	**-0.0994**	**0.2724**	**0.2446**	**1.2390**
Center	0.0063	-0.0286	**-0.1186**	**0.1262**
South	**-0.2107**	0.0071	**-0.3199**	**-0.2514**
Mexico City	**0.0558**	**-0.0597**	**-0.1018**	-0.0097
Division 2	**0.0889**	**-0.4067**	**0.0470**	**-0.4497**
Division 3	0.0027	**-0.7288**	-0.0219	**-0.4716**
Division 4	**0.0838**	**-0.4259**	0.0467	-0.0099
Division 5	**0.0816**	**-0.0889**	**0.0762**	**0.2960**
Division 6	**0.1058**	**-0.7046**	0.0390	**-0.5756**
Division 7	**0.0682**	**0.2049**	**0.0644**	**0.6441**
Division 8	**0.0334**	**-0.3268**	**0.0735**	-0.0349
Division 9	0.0596	**-0.6036**	0.0355	**-0.3742**
Permanent	**-0.0892**	**-0.0853**	**0.0314**	**0.0744**
Tech. Adop.	**0.0257**	**0.0878**	**0.1180**	**0.2016**
Foreign Cap.	**0.0663**	**0.5439**	**0.1327**	**0.2832**
Exports	**-0.1263**	**-1.0886**	-0.0098	**-0.2456**
Qua. Control	0.0410	**-0.2300**	**0.0774**	0.1498
Union	**-0.2379**	**0.0985**	**-0.2822**	**0.1735**
Hours	**0.0684**	**0.0666**	0.0030	**-0.1506**
Ed*Gen	0.0008	**-0.0202**	-0.0069	**-0.0228**
InTr*Gen	**0.0247**	0.0111	0.0497	**0.2213**
ExTr*Gen	**0.0417**	0.0061	0.0333	0.1019
R&D	**0.0224**	**0.2010**	0.0224	**-0.2031**
Constant	**5.0979**	**2.6621**	**6.0442**	**3.5524**
R-squared	***0.5582***	***0.2444***	***0.5157***	***0.2654***
No. Obs.	6802		5757	

Coefficients in bold type are significant at 10% level

Table C2: Test of equality of the coefficients for the simultaneous estimation

Ho: coefficient varx[productivity eq.] = coefficient varx[wage eq.]		
Variable	**p-value (1993)**	**p-value (1999)**
Education	0.0000	0.0000
Pot.Exp.	0.0000	0.0000
Gender	0.0060	0.7080
In-houseTr	0.0006	0.7438
ExternalTr	0.0085	0.1590
Age Firm	0.8965	0.0000
Small	0.0002	0.0000
Medium	0.0001	0.0000
Lage	0.0004	0.0000
Center	0.2618	0.0000
South	0.0005	0.4030
Mexico City	0.0012	0.0916
Division 2	0.0000	0.0000
Division 3	0.0000	0.0000
Division 4	0.0000	0.4689
Division 5	0.0001	0.0004
Division 6	0.0000	0.0000
Division 7	0.0659	0.0000
Division 8	0.0000	0.0378
Division 9	0.0000	0.0000
Permanent	0.8993	0.3040
Tech. Adop.	0.0197	0.1340
Foreign Cap.	0.0000	0.0058
Exports	0.0000	0.0000
Qua. Control	0.0000	0.5058
Union	0.0000	0.0000
Hours	0.9327	0.0000
Ed*Gen	0.0021	0.1707
InTr*Gen	0.1077	0.0461
ExTr*Gen	0.0000	0.4804
R&D	0.0000	0.0167

If p-value<0.10, then Ho can be rejected

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